## The Eurocontrol Experimental Centre (EEC) Safety Research Team (SRT) Portfolio

Safety is of increasing concern in ATM, as ATM systems are evolving at a rapid rate, traffic is increasing, and there have been two recent tragic ATM-linked fatal accidents (Lake Constance and Milan). There is therefore a need to ensure that EEC projects are contributing positively to future ATM safety. There is also a need to support Eurocontrol Agency safety initiatives, such as the implementation of safety management systems (including hazard assessment and safety assurance) across ECAC states, and the post-**AGAS** (European Action Group on ATM Safety) work plan developed following the mid-air collision last July.

There are therefore a number of projects based at the EEC aimed at helping to better understand and resolve current and future ATM safety issues. Safety is no longer a business area (BA), and so a number of the projects are being embedded into the new BAs. However, certain projects are of general benefit (i.e. serving more than one BA), and some projects are directly for support to HQ Safety Units. Therefore some projects reside outside the BAs and are instead 'housed' within the SAS (Safety & Scientific) Centre of Expertise (CoE). A group of around 12 people from different CoEs aim to 'animate' and support safety at the EEC, and are called the Safety Research Team (SRT). The administrative location for safety activities resides in SAS.

There are four main orientations of the work: Design, Organisational Learning, Assessment, and Operations Support. **SAFBUILD**, a project moving into the SSP Business Area, aims to determine how to build safety into the design processes from an early stage. It focuses particularly on EEC projects, and aims to give these projects all the safety information they may need in an accessible way. **SAFSIM**, linked to SAFBUILD, aims to be able to gain more focused safety insights from real-time simulations.

**SAFLEARN** is a programme of work aimed at learning how to be safer, based on analysis of incidents and operational events, whether these events are recorded by **ACAS**, or tools such as Automatic Safety Monitoring Tool (**ASMT**), or from actual incident reports. It aims to distil learning lessons for EEC design projects, as well as for operations and safety assessment.

**SAND** is aimed at EEC projects, ensuring that these will have the required safety assurance activities (e.g. some type of hazard analysis) to ensure we design safer concepts and systems. **SAFMOD** is aimed at developing new safety assessment approaches to improve safety, for example new techniques to reduce level busts, and new approaches to assess human error, as being explored within the **GBAS** and **MFF** projects. SAFMOD is a programme of work currently focused on determining the **Target Level of Safety** for projects, and new techniques to be adapted in SAND or in the EATMP Safety Assessment Methodology being developed by HQ.

Following AGAS, there will be a number of targeted safety R&D projects, as defined in the AGAS final report. Two of these that are about to be launched concern level busts and airspace complexity. The **level busts** project aims to understand more deeply the causes of level busts, and therefore to derive remedial measures. Currently there are several level busts per hour in European airspace. **Safety & Complexity**, a project to be embedded within the Network and Capacity Business Area aligned with the **COCA** project, aims to understand the limits of airspace/traffic complexity for controllers, i.e., at what point safety will be compromised by increasing complexity, and how to better equip controllers to deal with this complexity. Other AGAS-related projects will be initiated later in 2003 and 2004.

The following information sheets further define the projects, with principal contact details.

***6 May 2003***
***Barry Kirwan***
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## SUMMARY

# 1. DESIGN & SAFETY

## 1.1. SAFBUILD

### Why ?

It is suggested that 60% of accidents have their root causes in design. This therefore means that we have to improve the degree of safety built into the design itself, and the design process. Safety is not something that can be added efficiently nor effectively to a system design as an after-thought. Similarly, if safety has not been 'built into' the system, as a 'property' of the system, then the designed system cannot be expected to pass independent safety audits with flying colours.

### What ?

The question for design projects, is therefore one of determining what design practices and safety considerations are most beneficial to assuring a 'safe design'. This programme called 'Design for Safety' [SAFBUILD] aims to answer this question, deriving practical, cost-effective approaches that can be fitted easily (cost-efficiently) into the design process, that will help ensure that the design is safe, and will be assessed as safe. These approaches must also not constrain the creative processes essential to successful design and innovation

### How ?

The work is in several stages:

1. Review of safety methods for assessing safety of new designs *( completed & report in progress*)
2. Survey of EEC design project safety practices and needs
3. Development of information systems to support design project safety needs
4. Development of a process for ensuring that safety is built into the system design architecture via the requirements engineering process
5. Assurance of safe recovery should the system or tool fail or generate bad data (Recovery from System Failure – linked to HQ's SHAPE project)
6. Determination of best practices for simulation assessment of new designs (SAFSIM project)
7. Assessment of best practices for assuring safe transition to operations (will link to EATMP System Safety Assessment)

### When ?

The project began in 2002 with an extensive review of >500 safety techniques, and the selection of 19 for usage in safety assessment of designs. Some of these techniques have already been 'trialled' at the EEC (TRACER & HAZOP), and these and others will form part of the basis of SAND (Safety Assessment of New Designs), the approach for assessing the safety of EEC projects. Items 2 & 3, and possibly 4, will begin in occur in 2003. Item 5 is under development as part of the SHAPE programme of work by HUM in Brussels, and will be continued at the EEC when the SHAPE project finishes (2004). For SAFSIM, see the separate portfolio sheet. Item 7 will commence in 2004. Overall the SAFBUILD project will run until 2005, and the major emphasis throughout this period will be on item 3.

### Where ?

Items 4 & 5 are based in HQ, otherwise the work will occur at the EEC. Item 7 will in particular involve a number of ANSPs in the process of transition (or recently transitioned).

### Who ?

On the EEC side, barry.kirwan@eurocontrol.int has been involved in forming SAFBUILD and managing the NLR survey of safety methods. Following the EEC Re-organisation, there will be a transition of this project into the SSP Business Area, to be run by alistair.jackson@eurocontrol.int.
Fabrice.drogoul@eurocontrol.int will be working on a number of the items (e.g. 2, 4, and 7 above).

## What benefit ?

The output will be a set of information systems, processes and guidance enabling design projects to make their designs safe throughout the design process. The resultant ‘package’ will be tailored to EEC user needs and processes and will cover hardware, software, and human aspects of safety in design.

## 1.2. SAFSIM

### Why?

Simulations are a significant pre-implementation test for evaluating new ATM systems as they offer opportunity to learn "without risk" about system safety weaknesses. So far rather implicit in simulations, safety issues shall now be processed in a more formalised and systematic way.

### What?

The final aim of the project is to deliver a validated guidance document which would give to the simulation project teams a methodology for better addressing safety in simulations and for ensuring a proper documentation, dissemination and follow up of simulation safety findings. The word simulation shall in principle encompass all types of simulations whereas it is anticipated that real-time simulations would provide most of the outputs. In the short term.

### How?

The project will develop in three phases:

- research: survey and aggregation of current practices to address safety in simulations,
- development & validation (through simulations) of the SAFSIM guidance document,
- promotion of SAFSIM findings and safety culture in simulation projects.

### When?

The project started effectively in August 2002 and is expected to last two to three years.

### Where?

SAFSIM will be run at the EEC Brétigny. It shall interface with Eurocontrol HQ, EEC projects & HF lab, and with external laboratories working for "ultra safe" systems.

### Who?

SAFSIM human resources consist of:

- a project leader (operational expert): *yann.kermarquer@eurocontrol.int*
- a contractor (Hum Fact/safety expert) from TRANSICIEL: *andrea.antonini@eurocontrol.int*

### What benefit?

Benefits will be two fold:

- to better and more explicitly address safety issues and then allow a more efficient risk mitigation prior to system implementation,
- to better follow up the implementation of safety recommendations and build up of lessons learnt.

# 2. SAFETY LEARNING

## 2.1. SAFETY LEARNING - SAFLEARN

### Why?

The safety of new ATM systems today is assured by safety assessments that are often carried out late in the design process. There is a need to build safety into the design process from a very early stage. For this to be done safety information needs to be provided to designers. This information is available in principle from Member States, from their incident and accident reports and from their Safety Managers. However, there is no structure in place that assures that the information is relayed from the operational setting to projects at the EEC involved in the design of future systems.

### What?

The initial phase of the project will define the requirements that Project Managers and their teams have for a safety database that would help inform their projects. A process will be created not only to collect and collate this data from different sources, but also to provide it to designers in a format that will support them in their design decisions and ensure safety is built into the system from the very beginning. This project aims at designing a process to establish a database of safety 'lessons learned' to inform the projects carried out in EEC.

### How (the approach)?

The first phase of the project will examine the need and the establish format for design information. The project will establish from where appropriate data will be derived and how it should be presented to be understood and easily used. In some other industries, for example, design projects can access databases of previous incidents to see what has happened before, that is related to a particular design project. The project will draw on experience of databases of 'lessons learned' used by such designers. The project will then apply the experience gained from the EEC's major role in safety occurrence collection, analysis and exchange and put this to use by establishing a process of collection, analysis and presentation for ATM design. The analysis of incidents or events is currently fed to operations very quickly for safety management. The aim is for these also to be distilled for design projects such as those at the EEC.

### When?

The first Data Collection and Analysis phase will run from mid May to December 2003. This first phase will aim to include provision of data to a selected project to test the process. The second phase in 2004 will establish the process at the EEC.

### Where?

The work will be carried out both on and offsite at the EEC Bretigny France, EU JRC Ispra Italy and at partner sites in member States.

### Who?

SAFLEARN project manager *anthony.joyce@eurocontrol.int*
Principal partners are Eurocontrol Safety Management, ANSP's, National Regulators, EU EASA and ICAO.

### Benefits?

Through the EEC's contribution to ATM safety occurrence data gathering, investigation, analysis and exchange, safety professionals are able to build up knowledge and insight of existing and near term safety problems. This knowledge can not only help operations, but can also be fed forwards into design. This creates a safety learning cycle: learning from incidents and safety-related events feeding back to operations and forward to design; assessment of design feeding forward to operations, in terms of how to operate more safely and how safe the system should be. This safety learning cycle is not yet fully developed in ATM.

A key program at the EEC will therefore be the development of Safety Learning approaches. The EEC will gain from its major role in safety occurrence collection, analysis and exchange, putting this to use by establishing a process of analysis to determine the right lessons for the industry. The primary focus of such analysis will always be Operations, since analysis of incidents or events can deliver lessons that need to be learned very quickly before an accident happens. But lessons also need to be distilled for design projects such as those at the EEC. In some other industries, for example, design projects can access databases of previous incidents to see what has happened before, that is related to a particular design project. This function is needed to support EEC design and concept work. The **SAFLEARN** project will aim to develop such a capability, ensuring learning does not only keep us looking in the rear view mirror.

## 2.2. SAFETY LEARNING - ASMT & SHIELD

### Why?

This work is a part of the EEC's contribution to ATM safety occurrence data gathering, investigation, analysis and exchange. It forms a part of a part of the "Safety Learning" family of projects. The analysis of incidents or events can deliver lessons that need to be learned very quickly before an accident happens. Although the primary focus will always be Operations, such lessons also need to be distilled for design projects such as those at the EEC.

### What?

The SHIELD project provides a major element of Eurocontrol's work to facilitate safety related occurrence reporting, analysis and dissemination. The aim of the work is to facilitate the exchange of safety information between ATM Organisations and regulators in Europe in order to better understand potential key safety risk areas. The work supports the activities of the EATMP Safety Group and the Safety Regulation Unit.

ASMT is Eurocontrol's project to develop the concept of automatic safety data gathering.
Currently most states rely mainly on safety occurrence data gathering through manual reporting methods. ASMT provides automatic data gathering to consolidate this existing data. The ASMT provides details of not just major safety occurrences, but also the minor but potentially operationally significant ones that can help ATC operations, with a more accurate overview of the current levels of safety.

### How? *(the approach)*

***SHIELD***

The current phase of the work, which was started in 2001, includes the implementation of the HEIDI ATM Safety Occurrence taxonomy in software tools and the transfer of data between ATM safety occurrence databases. A part of this task is being done in co-operation with the European Commission and its Joint Research Centre (JRC), who have developed the ECCAIRS tool for reporting Aviation Safety Accidents. Eurocontrol input to this work has been the joint development of the MEPHISTO data conversion tool and assistance in the ATM components for ECCAIRS 4 and ICAO ADREP2000. With the advanced level of maturity of the development of the above products, the project planning now indicates an increased requirement for support to the ATM community in implementation.

***ASMT***

The ASMT (Automatic Safety Monitoring Tool) provides an automatic monitoring facility for safety related occurrences using operational data. It detects and classifies each occurrence for evaluation and assessment by operational experts. This tool also assists operations staff to determine causes of individual safety occurrences, as a method to improve safety by identification of potential risks for example due to existing procedures, changing traffic patterns or airspace design. Though not a mandatory requirement, it is now becoming widely accepted that automatic safety data gathering can provide a valuable element of an ATM safety management system.

### When?

***SHIELD***

The SHIELD Project will include both development and support elements during 2003 and 2004. It is likely that there will be a continuing requirement for support to ANSPs and Regulators post 2004.

***ASMT***

An increasing number of ANSPs wish to implement Automatic Safety data gathering within SMS. During 2003 and 2004 the ASMT Project will develop with industry a process whereby ANSPs will implement ASMT based on EATMP standard operational requirements and operational guidelines.

## Where?

The work is carried out both on and offsite at the EEC Bretigny France, EU JRC Ispra Italy and at customer sites in member States.

## Who?

SHIELD project manager *anthony.joyce@eurocontrol.int*
SHIELD technical support *paul.farr@eurocontrol.int*
ASMT project manager *brian.hickling@eurocontrol.int*
ASMT operations *anthony.joyce@eurocontrol.int*
Principal partners are Eurocontrol Safety Management, Eurocontrol Safety Regulation Unit, ANSP's, National Regulators, EU EASA and ICAO

## Benefits?

The importance of Safety Learning through occurrence data for Safety Management and Safety Improvement is widely acknowledged in the ATM community. It remains a very high priority for our partners. AGAS has identified ATM safety occurrence data gathering (mandatory, voluntary and automatic systems), investigation, analysis and exchange in its list of priority actions. Through the EEC's contribution to ATM safety occurrence data gathering, investigation, analysis and exchange, safety professionals are able to build up knowledge and insight of existing and near term safety problems. This knowledge can not only help operations, but can also be fed forwards into design.

## 2.3. SAFETY LEARNING - ACAS

### Why?
Airborne Collision Avoidance Systems (ACAS) have been mandated for large aircraft by member states since 1 Jan 2000. There is a need to ensure that ACAS continues to provide an improvement to ATM safety and to ensure that this benefit is as large as can be operationally achieved.

### What?
The ACAS monitoring project receives reports of events involving ACAS, analyses them and provides immediate feedback to the parties involved and also longer term analyses and annual statistics to the broader ATM community.

### How? *(the approach)*
Details of individual events are stored in a database. Unusual events, or events of particular significance are investigated in more detail – requesting radar and other data where appropriate. Whenever radar data is provided we simulate the action of ACAS in the incident and write a report. This report is normally sent to the airlines and control centres involved. If unusual events are found, a search is made for other events resembling this. If several are found, a paper will be written and presented to the international community via the operational monitoring group that meets 3 or 4 times per year, and via ICAO SCRSP (Surveillance and Conflict Resolution Systems Panel).

### When?
The ACAS Monitoring Project started in 1993 and support from the ACAS programme will finish October 2004. There are plans to transfer the basic monitoring functions to member states as part of their standard safety monitoring. It remains to be seen whether or not member states will be willing to pay for a continued service that co-ordinates and analyses TCAS events.

### Where?
The work is carried out at the EEC Bretigny France – with missions to member states, Brussels and ICAO meeting destinations.

### Who?
ACAS monitoring project manager *garfield.dean@eurocontrol.int*
ACAS monitoring technical support *tim.baldwin@eurocontrol.int*

Principal partners are Eurocontrol ACAS Programme, ANSP's, Airlines, National Regulators, and ICAO.

### Benefits?
- Feedback to the operational community on the effectiveness of ACAS,
- Suggestions on how to ensure that ACAS is operationally used to the best effect,
- Detection of problem areas in the airspace,
- Accident and airprox analysis as required,
- Identification of problems with ACAS itself. (The multi aircraft logic is still largely untested in operation).

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## 2.4. TRANSPARENCY

### Why?

Demands for "Transparency" from the public seems to be a growing tendency in our modern societies. In high risk organisations, this takes on an even more stringent aspect. Within a changing context (privatisation, separation of providers and regulators, implementation of European Regulation) ATM is particularly concerned with issues linked to transparency on safety aspects. Particularly illustrative are the issues linked to incident reporting, organisational learning, and the implementation of Automatic Safety Monitoring Tools.

### What?

The project consists of analysing sociological issues linked to transparency in high risks organisations. The focus is on the ATC domain, but some comparison will be drawn with other domains (Nuclear, financial). The issues of trust and power struggles, as well as more symbolic aspects (the different senses given to safety according to the different actors and public points of views) are explored.
The final deliverable is the PhD and a summary in English.
Additional deliverables are provided every 6 months, in the form of presentations or advancement reports.

On line available documents (on Eurocontrol site)

- "La transparence en questions: le cas des incidents dans le contrôle de la navigation aérienne". Mémoire de DEA. Septembre 2001.
- Summary in English

Other documents/presentations on request:

- journées Facteurs Humains de la Sorbonne. "Transparence et secret dans le contrôle de la navigation aérienne". January 2002.
- Présentation et avancement (Avril 2002)
- Compte-rendu d'avancement (Octobre 2002)
- Automatic Safety Monitoring issues . (presented by Tony Joyce at the Glasgow Incidents analysis workshop). July 2002.
- Congrès HIAS : "Stakes of transparency in ATM organisations". Septembre 2001.

### How?

Combines a theoretical work on the notion of transparency, and field studies. The theoretical framework comprises, amongst others, the High Reliability Organisation work (Berkeley HRO group), and the strategical analysis of organisations approach (Crozier/Friedberg). The field study consists in a comparative sociological analysis of ATC organisations, including : France, Denmark, Sweden, Slovakia, Italy (and another smaller organisation to be defined). It involves socio anthropological methods, and interviews with many actors (controllers, safety managers, supervisors, decision makers, controllers, regulation authorities). There is also a focus on the issues linked to some ESARRs implementation which involves the participation as an "observer" to different working groups safety meetings.

### When?

The project started in December 2000. First year (till September 2001) was dedicated to a pre study. The study finishes in March 05.

## Where?

Work is carried out in CETCOPRA (laboratory of socio anthropology in Paris 1 Sorbonne University).
The project resides in the SEE Business Area.
Interfaces with HQ : through the study of impact of ESARR 2 and 3.
Interfaces with ANSPs : through field studies in 5 or 6 ANSPs.

## Who?

The work is carried out by Christine Fassert, PhD student, and directored by Sophie Poirot Delpech (Maître de conférence in Paris 1 Sorbonne).

## Benefits?

This study reframes the issues linked to transparency in ATM organisations in a more global framework. It gives some insight on sociological and political sciences points of views that are not much explored yet in the ATM domain, compared to more classical engineering and HF (psychological) points of views. It helps to understand the issues linked to trust building between a high risk organisation and its public, and the difficulties linked to safety regulation implementation in Europe.

## 2.5. SAFETY MATURITY IN THE EEC (SAF MAT)

### Why ?

Analysis of aviation incidents has indicated that 60% of incidents are due to design problems. However, it is difficult to know from this data how to improve design, due to the small number of occurrences and the lack of detailed information from such incidents. It is therefore important to collect other measures of safety data. By measuring the Safety Maturity of an organisation, it is possible to detect areas of weakness and therefore identifying areas for improvement, such as higher levels of safety awareness, more active participation in safety activities and more structured and systematic approaches to safety. It is hoped that with a more mature safety culture, the safety of ATM tools and systems will be enhanced.

### What?

The project will measure the maturity of safety in the EEC with regard to the commitment of management to safety, the organisation and planning of safety activities, the participation of employees in safety and the evaluation and auditing of safety. Methods to improve safety maturity will be discussed and implemented. The safety maturity at EEC will be reassessed annually.

### How ?

A safety maturity model and questionnaire was developed based on previous models of safety maturity (Feb) and the questionnaire was distributed to a cross-section of 40 staff and contractors at the EEC (March). The data were analysed and a report of the results was written (April). The results were fed-back to the EEC at the Weekly Information Corner (May). SAGE (Safety Awareness Group in Eurocontrol Experimental Centre) will discuss the steps that need to be taken in order improve safety maturity. The EEC will be resurveyed in 2004.

### When?

The project started in February, 2003. This is an on-going process. It is anticipated that the next survey will be undertaken in June, 2004.

### Where?

The work has been carried out in-house at EEC (R. Gordon). SAGE will be involved in discussing and implementing methods to improve safety maturity.

### Who?

The work has been led by *rachel.gordon@eurocontrol.int* and SAGE.

### What benefits ?

By measuring Safety Maturity in the EEC, a more specific knowledge of problem areas can be achieved, and hence a more specific focus on safety needs in new ATM concepts. The ultimate benefit for ATM safety will be safer designs of tools and systems.

# 3. SAFETY ASSESSMENT

## 3.1. SAND (Safety Assurance for New Designs)

### Why?

Whenever EUROCONTROL has helped to develop a concept or system, some of the initial outputs from research projects will carry over into the actual implementation. Therefore, EEC (EUROCONTROL Experimental Centre) projects have the responsibility to evaluate their potential safety impact, and should improve safety where possible, and at least should record safety issues and insights for future potential implementation.

### What?

The aim is to develop a safety assessment methodology compatible with the full range of EEC projects by providing an approach that is flexible and adjustable for different project needs, using an appropriate level of resources.

### How?

The SAND project is essentially based on EATMP (European Air Traffic Management Programme) Safety Assessment Methodology (SAM).
The SAND approach encompasses:

- Initial assessment of potential safety impact of a project;
- Guidelines for the development of a Safety Plan for a project;
- Guidance for the risk assessment for a project based on "Safety methods survey",
- Recording, monitoring and summary of safety issues for a project.

### When

The SAND project should start mid 2003 and be completed in 2005.

### Where?

The SAND project will be carried out largely at EEC. It will get safety expertise support from external contract. It will be co-ordinated with EUROCONTROL SMU (safety management unit) in HQ.

### Who?

The project will be carried out at EEC, with the following EEC personnel involved:
catherine.gandolfi@eurocontrol.int as project manager;
barry.kirwan@eurocontrol.int as SRT (safety research team) manager.
Marc.withley@eurocontol *int* involved in SAND activities

SAND promotes a "pro-active" and when possible a "generative"[1] attitude towards safety. SAND intends to provide straightforward templates with explanatory guidelines and illustrative examples from EEC projects. SAND aims to address "significant" results with high-level of return on investment.

[1] Pro-active attitude can be described as "We still work on the problems we still find". In the "generative" attitude, "Safety is our business and is fully integrated in everything the EEC does" (adapted from Professor Patrick Hudson from Leiden University).

## 3.2. SAFETY METHODS SURVEY

### Why ?

The EATMP SAM states what to do to carry out FHA, PSSA, and SSA, but not how to do it in detail. There is therefore a need for guidance on techniques that can achieve these safety assessment functions.

### What ?

The aim was therefore to see what techniques are available, either from ATM safety assessment practices, or from other industries. A review of more than 500 techniques from nine industries therefore took place.

### How ?

The project searched databases and used contacts to find all the techniques, and then a multi-expert panel was convened to select the usable techniques for the EATMP SAM.

### When ?

The project started effectively in July 2002 and will finish in April 2003.

### Where ?

The survey was carried out largely at NLR in consultation with safety experts in the EEC and in Eurocontrol HQ.

### Who ?

The survey was carried out by NLR, with the following Eurocontrol experts involved:
Barry.kirwan@eurocontrol.int as project manager;
Patrick.mana@eurocontrol.int as main 'client' for the results of the work;
Mete.celiktin@eurocontrol.int involved as a software expert ;
Oliver.straeter@eurocontrol.int involved as a Human Factors expert.

### What benefit ?

Twenty techniques have been identified that can support the SAM process. A further number of techniques have been identified that need to be developed for ATM safety assessment. Together, these techniques will enhance the power of safety assessment and assurance for Eurocontrol and Member States' projects. In particular, several techniques are now being considered for development. Tralers is a human error analysis technique and has been applied in EEC in a trial exercise to CORA, Time-Based Separation and Co-space. HAZOT was also applied to these three projects and further application is occurring on MFF and Co-Space. Training on TRACER is planned later in 2003.
Hazard tracking is a mean of ensuring all identified possible hazards are resolved during the system design life cycle and this approach will be developed for GBAS and then developed for others projects.
Other techniques defined in the review will be further developed for EEC and EATMP in 2004.

## 3.3. TARGET LEVEL OF SAFETY APPORTIONMENT METHOD

### Why ?

European ATM has adopted the recent trend towards objective-based safety regulation, in which safety, and the proof thereof, is more clearly the responsibility of the service provider.
EUROCONTROL's ESARR 4 enshrines this approach, defining a numerical Target Level of Safety (TLS) representing acceptable risk for ATM in its entirety.
The introduction of a numerical TLS has raised the problem of how to apportion the target within and between individual ATM systems.

### What ?

The aim was therefore to:
Apportion the ESARR 4 TLS (for events of severity category 1 i.e. accidents) to ATM systems.
Set numerical safety objectives to events of severity categories 2 to 4 i.e. incidents of the Risk Classification Scheme of ESARR4.
It is intended as an Acceptable Means of Compliance (AMC) with the TLS apportionment aspect of ESARR 4.

### How ?

After introducing a number of safety engineering concepts, a three-stage methodology is defined for the TLS allocation process: those stages are: (i) definition of the safety requirements that apply to the ATM service; (ii) definition of a set of safety specifications for the overall ATM system (based on a functional modelling); and (iii) allocation of the ATM system-level safety specifications to the physical elements of the system – including equipment, people and procedures.
Applicability of the methodology has been tested on two examples: 1) GBAS CAT-I; and 2) Upper Area Centre (UAC).

### When ?

The project started effectively in September 2002 and will finish in April 2003.

### Where ?

The study was carried out by Praxis Critical Systems in close co-operation with safety experts in the EEC (Safety Research Team & GNSS Programme/GBAS Project) and in Eurocontrol HQ (SQS and SRU).

### Who ?

The survey was carried out by Praxis Critical Systems, with the following Eurocontrol experts involved:
*Barry.kirwan@eurocontrol.int* as project manager;
*Eric.perrin@eurocontrol.int* as first main 'client' for the first application of the work;
*Bernd.tiemeyer@eurocontrol.int* *and* *Patrick.mana@eurocontrol.int* to ensure that the derived methodology will support the Safety Assessment Methodology (SAM) process.
*Gary.morton@eurocontrol.int* to assess the applicability of the methodology as a means of compliance with the TLS apportionment aspects of ESARR4.

### What benefit ?

The method will help determine how safe system changes or new system developments need to be, to ensure that the ATM contribution to risk and safety is not increased, and is preferably decreased. The techniques that the method mentions will enhance the power of safety assessment and assurance for Eurocontrol and Member States' projects.

## 3.4. MFF : HUMAN Error Analysis (Human Factor Causes)

### Why does this work need to be carried out ?

A number of techniques have been developed for the analysis of human errors in ATM. It is necessary to test these techniques for their applicability and relevance to different projects/stages of projects, their usefulness for assessing human error in simulations and their applicability for feeding into Safety Cases.

### What will the project do ?

The project is part of MFF WA7 Safety Assessment of Real Time Simulation 2 (RTS2) which included testing the following applications: ASAS Spacing, Merging, Crossing and Free Route (February, 2003). After RTS2 a list of the observed hazards was compiled (March, 2003). The intention of the human error analysis is to analyse the observed hazards in more detail using TRACEr / HAZOP (April-Oct 2003). A comparison of the two techniques (TRACEr/HAZOP) will be undertaken. The results from the analysis will then be included in the Safety Case (2004).

### How the work will be achieved ? (the approach)

RTS2 was observed to identify the hazards. Some of the hazards will be analysed further with TRACEr and ATCOs (and possibly pilots) from RTS2 will be involved in HAZOP analysis to a small number of hazards. The results will be integrated into the other MFF safety assessments and eventually into the MFF Safety Case. A comparison of the TRACEr and HAZOP techniques will be undertaken.

### When the work will start/finish ?

The project started in JANUARY, 2003 (RTS2). Compilation of the observed hazards was undertaken in March, 2003. Analysis of the human errors / other human factors causes using TRACEr will be undertaken between April – May, 2003. A workshop (Siena) will provide the platform to discuss the results with the other members of the MFF Safety Team and pilots and ATCOs involved in RTS2 (June, 23-26). HAZOP analysis will be undertaken between July-October, 2003. The integration of the results into the Safety Case will be undertaken in 2004.

### Where the work will be done / what interfaces with HQ, ANSPs etc ?

Work will be carried out at EEC (R. Gordon, B. Kirwan) and a contractor (tba)
Interfaces with MFF WA7 Safety Team: Gerry MaCauley (Eurocontrol HQ); SQS; and ANSPs: DNA; ENAV; AENA; NATS; NLR. Interfaces with ANSPs (involved in MFF RTS2): checking TRACEr analysis at Siena workshop (MFF RTS2 ENAV ATCOs & pilots); HAZOP analysis.

### Who will do the work, points of contact ?

The work is carried out by rachael.gordon@eurocontrol.int, barry.kirwan@eurocontrol.int(EEC) and a contractor
. The internal client is *lucas.bellesia@eurocontrol* int

### What are the benefits for ATM safety?

The benefits for ATM of this project include:

1. Comparison of different techniques for analysing human error within simulations will provide information regarding the benefits/disadvantages of the different techniques.
2. Information regarding how this information can be fed back into the MFF Safety Case (and Safety Cases in general) / assessment of new tools.
3. Comparison of different techniques for analysing human error within simulations will provide information regarding the benefits/disadvantages of the different techniques.
4. Information regarding how this information can be fed back into the MFF Safety Case (and Safety Cases in general) / assessment of new tools.

# 4. OPERATIONS SAFETY ISSUES (post ASAS)

## 4.1. Level Bust

### Why ?

One of the most dangerous hazards that can happen during a flight was considered to be the Level Bust. Some studies were already made on this issue but the problem was not yet solved.

### What ?

The aim is to find out the causes of level busts and how to minimise the risk of level bust related accidents.

### How ?

Together with a team of experts, a set of use cases of Level Busts are going to be created with the help of the "SMART" tool. These cases are going to be compared with incident reports for conformity, the common elements of causes that produced Level Busts are going to be searched. The study will be done for a single type of area initially (probably TMA)

### When ?

The first phase of the project started effectively in February 2003 and will finish in December 2003.

### Where ?

The project will be managed by EEC, and for the first phase a contractor company "Dedale" will be hired to create the user cases.

### Who ?

The project will be carried out by EEC, with the following Eurocontrol experts involved:
*Adrian.gizdavu@eurocontrol.int* as project manager.
The ANSP NATS are likely to be involved.

### What benefit ?

At the end of the project we should have a better and deeper understanding of why Level Busts occur and clear recommendations on how Level bust can be reduced.

## 4.2. Safety and Complexity Study

### Why ?

Because complexity can have a large impact on safety of a certain airspace, defining what complexity is and how much complexity can be accepted by the controllers, are issues that can improve overall safety.

### What ?

The aim is to:

1. Define what "complexity" is and find out all its components.
2. Find the right measurements and tools to capture "complexity" elements that can be used for real time simulation exercises and live trials.
3. Investigate Maastricht UAC needs about safety concerns because of high "complexity" elements in their UAC.

### How ?

Find some complexity examples from MUAC and/or COCA and test them in a real time simulation using the humans factor lab. Measurements should be largely airspace traffic and procedures oriented without focusing on the impact of the HMI component.

### When ?

The project started effectively in April 2003 and the firdt phase will culminate with a small scale simulation in the Human Factors Lab the first three weeks of November 2003 and will finish in December 2003.

### Where ?

The project will take place and will be managed by EEC.

### Who ?

The project will be carried out by EEC, with the following Eurocontrol experts involved:

| | | |
|---|---|---|
| *1.* | *adrian.gizdavu@eurocontrol.int* | as project manager*;* |
| 2. | *racel.gordon@eurocontrol.int* | a Human Factors expert to create the "Experimental Plan" and follow up from the human factor view, |
| 3. | TBA | an IPAS preparator, |
| 4. | *yann.kermarquer@eurocontrol.int* | SAFSIM PM collaborator |
| 5. | *anthony.joyce@eurocontrol.int* | relation with Maastricht |

### What benefit ?

At the end of the first year of the project we should be able to understand what complexity is and how can this be measured in a real time simulation and in live trials so as to study the complexity impact on safety in a later stage.
For Maastricht, try to fulfil their needs if different from the ones stated above.

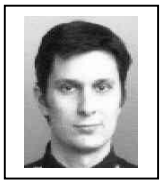
*For general information please contact the EEC Safety R&D Co-ordinator (Barry Kirwan, BS10, 7886).*

## SRT Team

**Barry Kirwan**

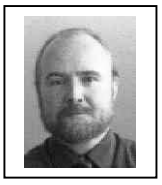
*SAFBUILD*
*TARGET LEVEL*
*SAND*
*SAFETY METHODS SURVEY*
*MFF*

**Fabrice Drogoul**



*SAFBUILD*

**Alistair Jackson**



*SAFBUILD*

**Garfield Dean**

*ACAS*

**Yann Kermarquer**

**Safety and Complexity Study**
*SAFSIM*

**Tim Baldwin**

*ACAS*

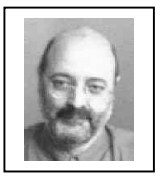
**Mark Withley**

**SAND**

**Catherine Gandolfi**

**SAND**

**Tony Joyce**

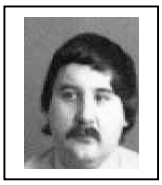


**SAF LEARN**
*ASMT & SHIELD*
*Safety and Complexity Study*

**Rachael Gordon**

*MFF*
*Safety&Complexity Study*

**Brian Hickling**



*ASMT*

**Adrian Gizdavu**

*LEVEL BUST*

*Safety and Complexity Study*

**Eric Perrin**

*TARGET LEVEL*

**Andrea Antonini**

*SAFSIM*